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Brine Curing of Hides and Skins

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Contents

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Historically, commercial brine curing of hides was originally developed in the meat packing industry of South America. The procedure followed there differs in several respects from the conventional domestic process described here. Two factors are responsible for this variation: First, the cheap labor rate in South America which permits use of more extensive manual operations; and, second, the practice of holding hides in pack for long periods in cellars in which temperature and humidity conditions are those of the prevailing weather. Furthermore, a very high percentage of these hides are exported and consequently are subjected to very severe conditions on shipment overseas.

In the United States the movement to interest hide producers in adopting a brine curing process received its early impetus from the late George D. McLaughlin during the early 1920's at the University of Cincinnati. Some 35 years ago he recognized the importance to the tanning industry of conserving, to as great a degree as possible, that component or ingredient of hides and skins produced by nature which is generally

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referred to as hide substance. The chemist has determined that it is a protein and has named it collagen.

A brief discussion of the composition of hide at the time it is flayed from the carcass may be of interest here. Like many natural products, moisture constitutes a major fraction and averages somewhere in the low 60's, percentagewise. Fat and oil are present in significant but variable amounts. The balance consists chiefly of the proteins, collagen, keratin (hair and epidermis), elastin, albumin, globulin, etc. The available leather forming material (collagen) in a freshly flayed hide will average about 30 per cent. As soon as the life process of an animal ceases, the organic matter comprising it is no longer able to resist the spontaneous decomposition that ensues. It is vital, therefore, to take prompt and adequate measures to arrest the forces that progressively, and with increasing tempo, convert this marvel of fiber structure into useless, offensive offal.

Prompt application of salt to the flesh side of hides and skins, as in the conventional green salting process, will accomplish this purpose by virtue of the production of brine through the dissolution of the salt in moisture present on and in the hide. This continuous exchange of moisture by salt proceeds, theoretically, until the residual moisture in the hide is completely saturated with salt. During this exchange the conditions for autolytic degradation of the hide become increasingly unfavorable but are never completely arrested. In fact, salt alone is incapable of effecting an absolute cessation of the action for indefinite periods, so that the beneficial effect of low temperature is put to use to create a more favorable environment.

From this it will be seen that this essential replacement of salt for moisture is dependent upon the continuous availability of brine. The degree to which

this condition is realized is one of the chief differences between green salting and the brining process as developed and used in this country.

The formation of brine at the flesh surface in the green salting method is not only controlled by the availability of moisture but is dependent upon the rate at which the solid salt dissolves. This rate is affected by the size or, more specifically, the extent of surface exposed to the dissolution forces of the solvent. No one will contend that a lump of sugar will dissolve as fast as an equal weight of the granulated form under otherwise similar conditions, but the statement that this phenomenon is the result of the difference in surface in contact with the solvent may not be so obvious. A simple example, however, will dispel any doubts of the accuracy of this claim.

When salt crystallizes from a saturated brine it takes the geometrical form of a cube. Let us suppose that we have a "king" size cube of salt which measures 2 inches on the edge. Each of its six facets has an area of 4 square inches or a total of 24 square inches available for contact with solvent. Now let us imagine that we have another cube of salt of equal dimensions and therefore identical in weight, since the density of pure salt has a constant value. Let us assume that this cube is divided into eight individual cubes of identical size or 1 inch on the edge. Each cube has a total facet area of 6 square inches and a total of 48 square inches. In other words, merely by decreasing the dimensions of the original cube one-half, the exposed area has been doubled.

Those who are mathematically minded can apply this calculation of progressively halving the linear dimension of the salt cube to the degree represented by "fine" salt and thereby find the answer to its increased

rate of solubility. Since the rate of salt take-up and consequent arresting of the spontaneous degradation of the hide are so fundamental and the added hazards contributed by bacterial contamination from the hair side of the superimposed hides of the pack are so factual, any means that ensures an ever present source of saturated brine should be looked upon with favor.

The role played by McLaughlin and his associates in advocating the use of brine curing by the domestic industry has been mentioned. However, the transition from laboratory-scale experiments to commercial application requires considerable study and adjustment before a workable procedure and processing equipment are finally developed.

This essential pioneering work was carried on by the laboratory and plant personnel of one of the larger producers of packer hides on a pilot plant scale. This phase of the development extended over many years due to the cautious attitude of the tanning industry of the mid-twenties toward investigating the merits of any raw material that had not had the benefit of years of tannery processing experience. However, a sufficient number of hide buyers became interested enough in this new cure for packer hides to give them a thorough trial.

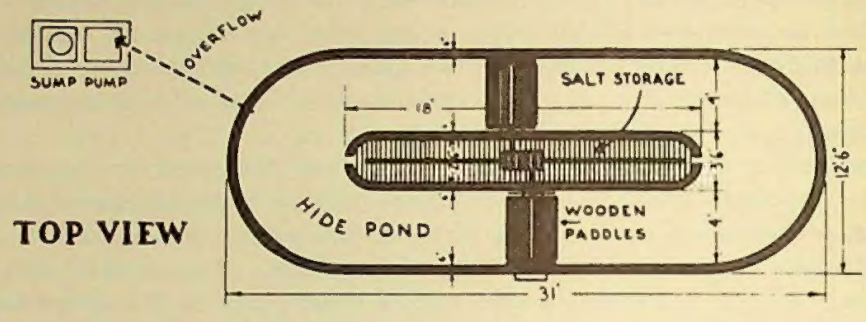
With this opportunity to demonstrate the quality of the product, it was only a matter of time until a sufficient demand developed to justify the installation of a commercial size unit at this packing plant, which was put on stream in 1935. Subsequently, this company installed this method of hide curing at four additional plants, and another large packer is employing the system at two of its plants. Brine cured hides have become firmly established as a standard product in the trade. Let us now turn to a description of the process as practiced today in the United States.

The brining process is carried out in a unit which has several novel features that represent a definite advance over South American practice. In place of a battery of small rectangular vats, a single oval shaped one is employed which has a capacity for about 25,000 pounds of green hide and five times this weight of saturated brine. A solid structure is centrally positioned, producing in effect an endless mill race. Two large, motor driven paddle reels, which are mounted at diagonally opposite positions on the vat, rotate in the same clockwise direction and serve to keep the hides moving continuously while the reels are operating. This action not only serves to expose the entire flesh side of the hides to the action of the brine but also helps to keep its strength at a uniform level.

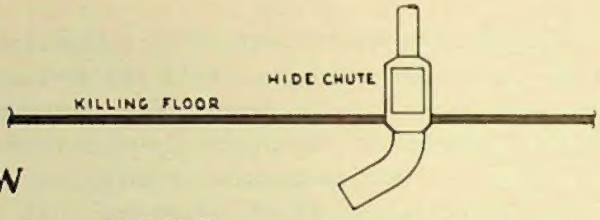
Another advanced feature of this brining unit is the auxiliary equipment with which the strength of the brine is maintained at or close to the saturation level in spite of its continuous dilution by moisture extracted from the hides. This accessory comprises a centrifugal pump of large capacity which circulates the brine from the curing vat through a salt restrengthening box where the brine is made to rise through a bed of rock salt and to overflow into a trough that returns the fortified brine to the curing vat. A duplicate standby pump is connected in parallel with this brine circulating system for use in case of failure of the other to function properly.

The cycle of brining operations begins with the vat filled with saturated brine to such a level that, when the full charge of hides is added, the final level will not be sufficient to submerge the entire paddle surface of the reel. Each freshly flayed hide, after trimming, grading, and weighing is placed in the brine bath spread out flat with its flesh side down. The revolving reels submerge and keep the hides in motion and in contact with the curing solution.

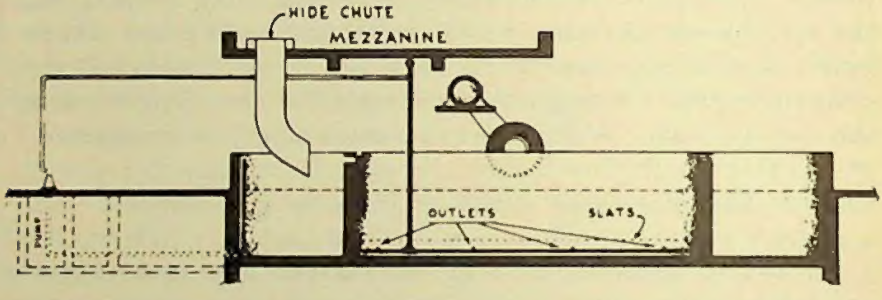
PLAN AND ELEVATION OF CURING TANK



TOP VIEW



SIDE VIEW



When a salometer test indicates that the brine is becoming significantly weaker, the pump is started to circulate the brine through the salt box. This agitation and circulation continues uninterrupted for 6 to 8 hours from the time the last hide is placed in the vat. From this point these operations are on an intermittent schedule of once an hour for such periods as conditions require.

The minimum brining period is 15 to 16 hours. The temperature of the brine varies with the season but is seldom outside the 60°-70° F. range.

After this over-night brining, the hides are removed by means of a mechanical device which consists of an endless chain equipped with hooks spaced at suitable intervals. A U-bend in the chain track permits the hooks to travel just above the brine level so that a man may grasp a passing hide by the head and hook it, through the eye-hole, to the traveling chain which pulls it from the bath and permits a substantial portion of the surface brine to drain off while the hide travels to a point where it is elevated and automatically discharged into a dump truck which transports the load to the cool (55°-60° F.) storage area. The drained brine flows by gravity to a sump from which it is pumped to the vat for re-use.

Hides brined in this manner have absorbed salt and lost moisture to such a degree that they are resistant to attack by proteolytic enzymes which are naturally present in the hide or are produced by bacterial contamination. Since any one batch of hides thus handled is made up generally of several grades and selections, it is necessary to hold them for such time as is required to accumulate a sufficient number of any given selection to constitute a carload shipment. Consequently, the hides are held in packs but no additional salt is required to maintain them in proper condition.

On delivery to the buyer, the hides are inspected in the same manner as green salted ones. Since such hides are exceptionally free from contamination by dirt and have no adhering salt, the customary "sweep tare" allowance, applied to green salted hides, has no basis in the case of brined hides and, therefore, these are delivered at gross weight, except for manure tare allowance when necessary.

Returning to the brining operation: After completing the cycle described above, a given batch of brine is used for a period of one week and is then replaced by an alternate batch which was in use the preceding week. The used brine is laden with suspended matter, blood proteins and, during the winter months, manure residue. Its total bacterial count is high but the proportion having proteolytic activity is comparatively low. However, to prevent this type of bacteria from building up to objectionable levels, the brine is transferred to a large vat where it is heated with live steam to incipient boiling. This operation serves to coagulate the blood and lymph proteins and to reduce the bacterial count to an insignificant level.

The coagulated proteins produce a thick scum on the heated brine which is skimmed off by means of a mechanical device. The heavier foreign matter, such as sand, dirt, etc., settles out and the layer of clarified, substantially sterile brine is separated, cooled to usable temperature, and held in storage vats until the following week when the process is repeated on the batch in current use.

This sterilization and clarification process entails the use of considerable amounts of steam and some power and labor. One large producer of brine cured hides considers it more economical to run the brine to the sewer after its protein content and bacterial counts have reached levels judged to be unsatisfactory. The usable period in

this case has been extended through the installation of a screening device as a section of the brine circulating system. This screen is in the form of a cylinder which revolves continuously as the brine flows through and is inclined slightly to the open end. Thus, the screen is self-cleaning and discharges into a hopper or truck the hair, straw, and other foreign matter removed from the circulating brine. The brine, after screening, continues its passage on through the salt box and returns to the hide vat.

The risk of developing an unsatisfactory level or type of bacterial flora is minimized through the daily addition to the brine of some bactericide, such as sodium hypochlorite or sodium silicofluoride. One hundred parts per million of available chlorine derived from the former or a few tenths of one per cent of the latter furnishes adequate protection.

Tannery experience with domestic hides, brine cured as described above, has demonstrated their superiority over hides cured by conventional green salting in these respects:

1. The cure is faster, more uniform, and affords greater protection whenever the product is subjected to adverse conditions during shipment or subsequent storage.

2. This cure practically eliminates the development of so-called "salt stains," even on prolonged storage, in contrast to salted hides after extended periods of storage.

3. These hides require no washing before "soaking back" in the tannery, thus permitting this operation to be shortened.

4. The leather produced from brine cured hides is plumper and has a clearer grain.

As indicated, this domestic process differs from that used to produce "Frigorificos" mainly with respect to the brining procedure and the use of salt on placing in pack.

It has been found that, after over-night brining with saturated brine, hides no longer lose weight. In other words, the exchange of salt for natural moisture has established a state of balance, and prolonged brining leads to a reversal of the weight change. Hides subjected to four days brining are found, on analysis, to have a higher percentage of salt and of moisture than those brined for one day. This means that brining beyond the point of maximum weight loss merely leads to absorption of brine (moisture + salt) by the hide and will necessitate longer holding in pack to secure a satisfactory shrink value. Hides brined over-night and properly drained subsequently will attain shrink values in line with those developed by comparable hides which have been green salted.

"Frigorificos," on the other hand, under the brining conditions practiced, do not reach the state of maximum weight reduction in the brining vat. The reason therefor is not obscure. Absence of adequate agitation for moving the hide, the gradual dilution of the brine, and the low ratio of brine to hide weights are sufficient to produce this result. It is understandable, therefore, that after such brining procedure it is necessary to complete the cure by salting in the pack. These statements are not made to convey the impression that conventionally processed "Frigorifico" hides are not of high quality. The points of difference in the curing procedures are emphasized to make clear the reasons for the difference in procedure.